Space Weather Technical Forecast

Issued on Wednesday, 31 January 2024 at 13:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated R1/R2 Radio Blackouts. Possible glance from CME and slight chance of peak G1/Minor Storm conditions Day 1 (31 Jan).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Low, with a peak flare of C5.7 from Ex-AR3559 over the northwestern limb, peaking at 30/1739 UTC. There are currently eight sunspot regions on the disc, five of which are numbered and three unnumbered. AR3567 in the northeast remains the largest and most magnetically complex region on the disc, with further increase in overall size and maintaining its small delta spot. AR3565 also in the northeast is a small region, but it comprises a north-south magnetic alignment in its leading portion, inferring some shear instability that could result in notable flaring. Other spots on the disc have generally shown some slow development, but remain fairly simple and stable at this time. A new, large region just rotating over the southeast limb may reveal more complexity at it rotates into clearer view.

No Earth-directed CMEs were evident in coronagraph imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR and ACE at L1 were indicative of a minor enhancement from a coronal hole, either CH94/- or CH95/-. The solar wind was at slightly elevated to elevated levels, peaking at 504km/s at 30/2152 UTC, but on a general downward trend with speeds decreasing from around 470km/s to near 420km/s. The solar wind density trace was largely below average. The interplanetary magnetic field (IMF), Bt, was weak with the north-south component, Bz, also varying weakly. The Phi angle was predominantly negative (towards the Sun). The net result of the above solar wind measures was Quiet geomagnetic activity (Kp 0-2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is currently at slightly elevated levels following the M6.8 flare on 29 Jan from EX-AR3559, but remains below the S1/Minor Storm threshold and continues to slowly fall.

GOES16 high energy (greater than 2MeV) electron flux was at normal background levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold on a generally steady trend. At 31/0000 UTC the 24-hour integrated fluence observation was 1.65e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low, but with a chance of increasing to Moderate with isolated M-class flares, most likely from AR3565 or AR3567.

Solar Wind / Geomagnetic Activity: One potential CME arrival features in the period, with a glancing blow possible later on Day 1 (31 Jan). Ongoing minor coronal hole influence is expected to wane in the coming days with speeds expected to ease to background levels. The next coronal hole enhancement is likely from Day 3 (02 Feb) onwards, with speeds increasing to slightly elevated and perhaps elevated levels at peak. Generally Quiet to Unsettled geomagnetic conditions are expected, with a chance of peak Active intervals and a slight chance of G1 Minor Storm conditions later on Day 1 (31 Jan). There is a further chance of isolated Active intervals

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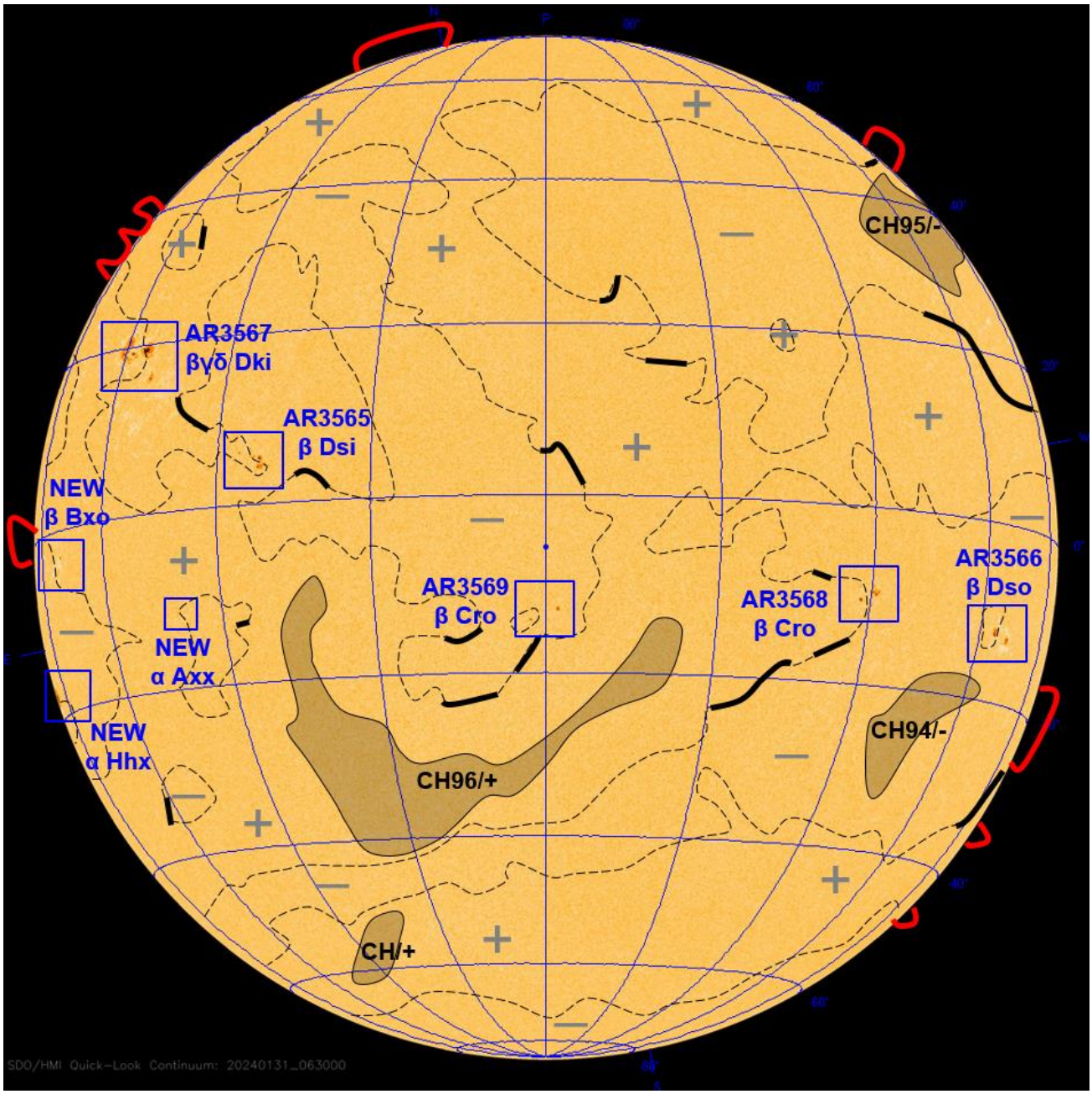
on Days 3 and 4 (02 and 03 Feb) in association with the next coronal hole influence.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain below the S1/Minor Radiation Storm level, with a nominal risk of exceeding the S1 threshold during the period. There is a slightly greater chance of this occurring on day 1 (31 Jan).

The high energy electron flux (greater than 2MeV) is expected to remain below High levels throughout the period, with exceedance of the Active threshold considered extremely unlikely.

Figure 1. Solar Analysis Valid 31/0630 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is one CME that currently features in the forecast period - that from the M6.8 from Ex-AR3559 at 29/0438UTC. MOSWOC Enlil modelling of this feature suggests the main bulk of the ejecta will pass well west of the Sun-Earth line on Day 1 (31 Jan). Having said this, the shock clearly shows a partial halo component. As things stand, the CME crosses 1AU ahead of Earth later on Day 1, with some ensemble members seeing a faint Earth glance from the flank.

Current solar wind conditions are indicative of a minor coronal hole fast wind enhancement, with the source likely CH94/- or CH95/-. This influence is expected to persist through Day 1 (31 Jan), but with an overall fall or slight downward trend in wind speeds as the connection to this feature gradually wanes.

The anticipated next coronal hole enhancement is from CH96/+ in the southern hemisphere. This coronal hole has two parts, a leading portion and a trailing portion which are tenuously linked via a narrow and faint section. The arrival of the leading portion at Earth may be as early Day 3 (02 Feb), though probably more likely on Day 4 (03 Feb). This is a recurrent feature and compares well in terms of location and size to the previous rotation. Therefore solar wind speeds may once again peak 450-500 km/s.

Generally Quiet to Unsettled conditions are expected through the period, with a chance of Active intervals and a slight chance of peak G1 Minor Storm intervals on Day 1 (31 Jan), dependent on any potential arrival from the 29 Jan CME. There is a chance for isolated Active intervals on Day 3 and 4 (02 and 03 Feb), due to the influence of CH96/+.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/0753	Partial	AR3559	NW Limb	1150km/s	31/1800 UTC	Shock likely with bulk of ejecta expected to miss Earth.

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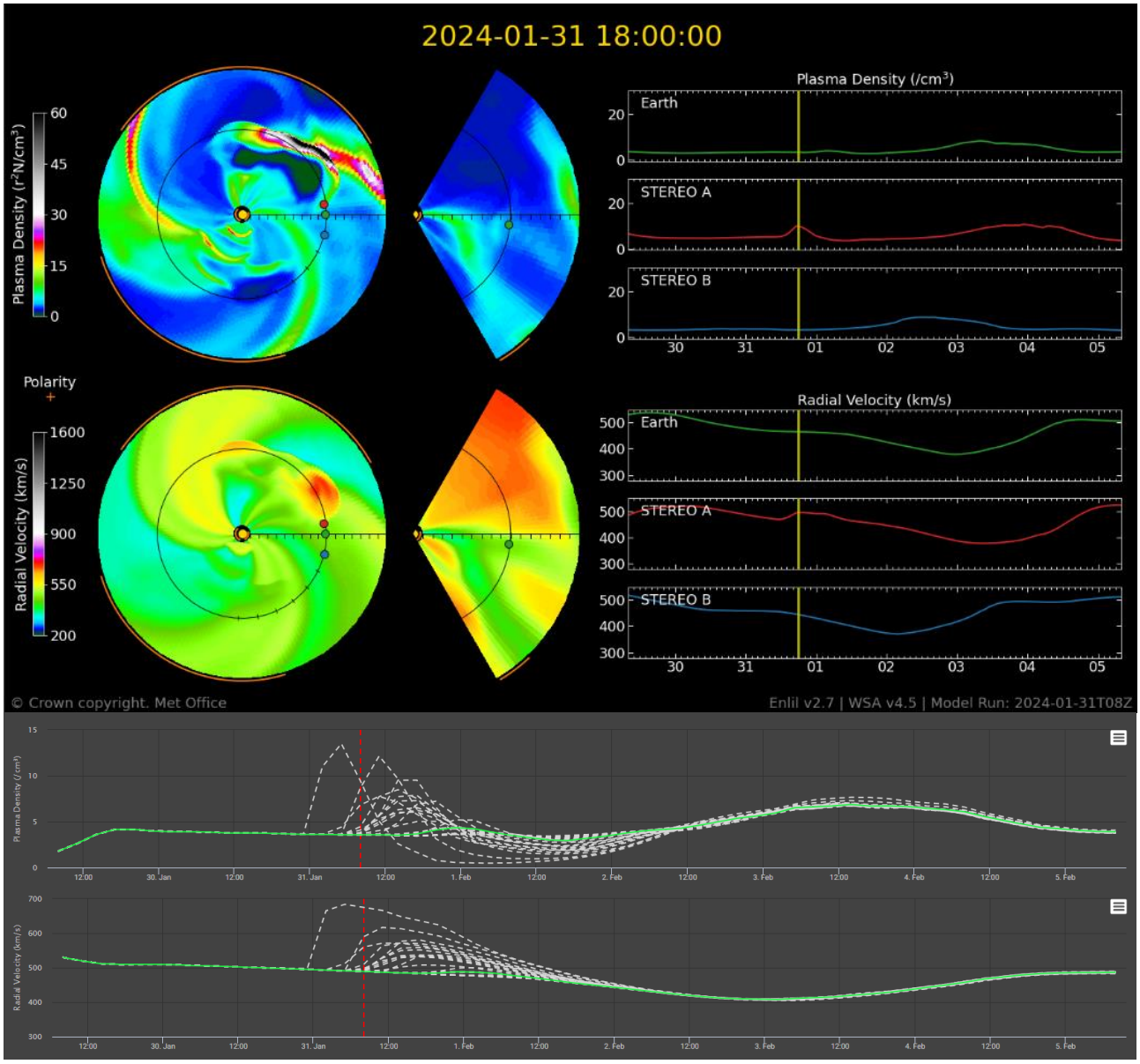
Figure 2: MOSWOC Enlil and Ensembles showing possible arrival times of CME from 29 Jan.



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Radio Blackouts - X-Ray Flares:

Low activity is expected with a chance of isolated M-class flares increasing activity to Moderate levels. This is most likely from AR3565 or AR3567, both located in the northeast disc.

There are currently eight sunspot regions on the disc, five of which are numbered and three unnumbered. AR3567 remains the largest and most magnetically complex region on the disc, with further increase in overall size and maintaining its small delta spot. AR3565 in the northeast is a small region, but it comprises a north-south magnetic alignment in it's leading portion, inferring some shear instability that could result in notable flaring. Other spots on the disc have generally shown some slow development, but remain fairly simple and stable at this time. A new, large region just rotating over the southeast limb may reveal more complexity at it rotates into clearer view.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES-16/18 X-Ray flux from past 24 hours

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Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is currently at slightly elevated levels following the M6.8 flare on 29 Jan from EX-AR3559, but remains below the S1/Minor Storm threshold and continues to slowly fall.

The risk of breaching the S1 threshold is now only a Slight Chance, primarily should there be any further large flares from Ex-AR3559 beyond the northwest limb in the current day (31 Jan). This risk reduces by day 2 (01 Feb) back in line with raw probabilities.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has spent the whole of the past 27-day rotation below High levels, with an absence of significant drivers to alter this state given the expected lack of potent coronal hole fast winds. Persistence suggesting significant electron flux is very unlikely following the current ongoing solar wind enhancement associated with CH94/- and CH95/-.

MOSWOC REFM's projections and persistence values both imply a continuation of the current background state, and this is the preferred forecast.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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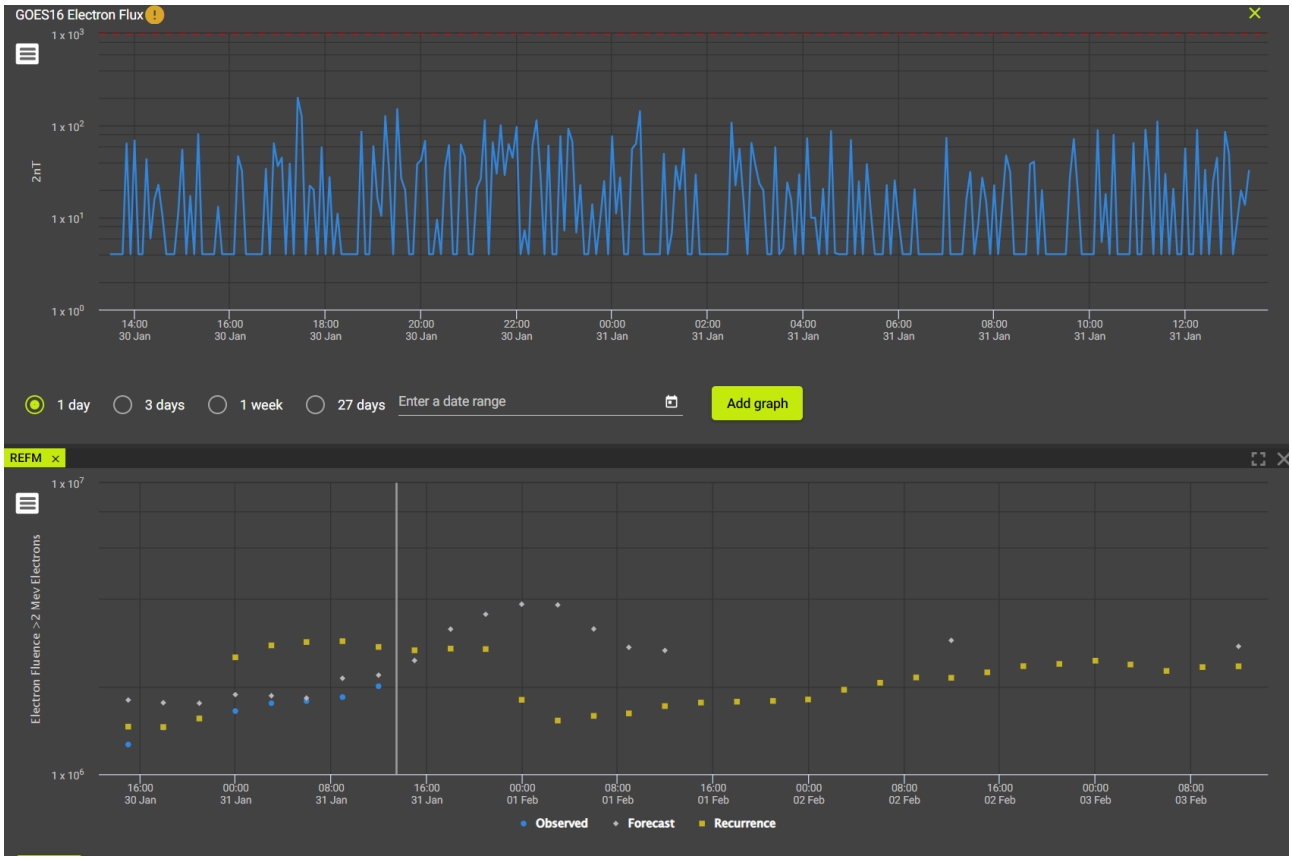
Figure 4: GOES-16 >2MeV Electron flux and MOSWOC Fluence forecast with recurrence



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